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Scotland, Hella ; Widmer, Jeannette D ; Wildi, Stefan ; Bueter, Marco ; Weber, Markus ; Muller, Markus K

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Original Article

How to cope with insufficient pneumoperitoneum and exposure when performing laparoscopic gastric bypass surgery

Hella Scotland*[2], Jeannette D. Widmer*[1], Stefan Wildi[2], Marco Bueter[3], Markus Weber[4], Markus K. Muller[1]

1 Department of Surgery, Bariatric Reference Centre, Kantonsspital Frauenfeld, 8500 Frauenfeld, Switzerland

2 Department of Surgery, Stadtspital Waid, 8000 Zürich, Switzerland

3 Department of Visceral and Transplantation Surgery, University Hospital, 8000 Zürich, Switzerland

4 Department of Surgery, Stadtspital Triemli, 8000 Zürich, Switzerland

* These authors contributed equally to this work.

Corresponding author:

Markus K. Muller, MD

Department of Surgery, Kantonsspital Frauenfeld

8500 Frauenfeld, Switzerland

Email: markus.k.mueller@stgag.ch

Phone: +41 52 7237241 Fax: +4152 7237804

Abstract

Objective: Despite following international guidelines and conducting routine preoperative dietary counseling, every bariatric surgeon will encounter technical challenges in laparoscopic gastric bypass surgery. We present a series of patients in whom the bariatric procedure was stopped after encountering insufficient exposure during diagnostic laparoscopy. These patients were sent back for dietary counseling and underwent surgery after conservative weight loss. The data from this two-step procedure are analyzed and discussed.

Methods: This concept was applied and studied in 14 patients from a series of 620 bariatric procedures. Patients who underwent a primary laparoscopic gastric bypass (n=593) were used as references.

Results: The patients in the study group were significantly heavier than those in the reference group (165 kg vs. 127 kg, $p<0.001$), with 79% a BMI >50 kg/m^2. The patients lost a median of 11 kg after two months of conservative treatment, and the mean BMI decreased from 55.7 to 52.6 kg/m^2. All patients in the study group underwent laparoscopic surgery for the second procedure with no need for conversion. The complication rate was not elevated in the study group. Overall hospital costs were higher for the study group compared with the primary laparoscopic bypass group (27,136 vs. 19,601 USD, $p=0.034$).

Conclusion: The primary laparoscopic procedure can be stopped in patients with insufficient exposure instead of undergoing conversion to open surgery. These patients may undergo successful laparoscopic procedures after conservative weight loss with no increased risk and with all of the possible benefits of a laparoscopic approach. As a result of this study, we have established a fixed, preoperative lower limit of 10% excess weight reduction before accepting superobese patients (BMI >50 kg/m^2) for surgery at our hospital.

Key words: morbid obesity, bariatric surgery, laparoscopic gastric bypass, technique, superobesity, two-step procedure, dietary counseling, preoperative weight reduction

Introduction

Limitations in performing laparoscopic bariatric procedures have virtually disappeared as surgical experience has increased. Indeed, heavier and superobese patients (BMI >50 kg/m^2 according to the American Society for Metabolic & Bariatric Surgery (1)) are undergoing laparoscopic Roux-en-Y gastric bypass procedures (RYGBP) despite the increased technical challenge with such patients.

Overall, gastric bypass procedures have a low mortality rate, e.g., a 90-day mortality rate of 0.04% (2). However, mortality rates are higher among superobese individuals (3), and patients who have open gastric bypass surgery suffer higher rates of adverse outcomes compared with those who undergo primary laparoscopic bypass surgery (4). Therefore, perioperative risk minimization and laparoscopic surgery are of pronounced importance for bariatric patients.

However, laparoscopic bariatric procedures, especially in superobese and male patients, can be technically challenging. Specifically, the exposure of the Angle of His may be very demanding. Schwarz et al. demonstrated that a large left liver lobe was the primary reason to convert from laparoscopic to open surgery in an analysis of 1,000 patients (5). This conclusion agrees with our experience that a massively enlarged left liver lobe impedes full exposure at the Angle of His. Additional obstacles, such as the heavy and short mesentery of the small bowel and the heavy abdominal wall, can make the gastro-jejunal anastomosis difficult or impossible to construct.

Preoperative weight reduction has been shown to decrease intra-abdominal fat mass and liver volume (6, 7). Additionally, large registry studies have demonstrated that the risk of postoperative complications is markedly reduced following preoperative weight reduction, especially in patients in the higher BMI range (8). Although much of the current data in the literature on the effects of weight loss prior to bariatric surgery are inconsistent for many outcome parameters, recent published results regarding the effects on postoperative complications and weight development over time strongly suggest that such a regimen should be recommended. Whether a specific degree of weight loss should be mandatory before being accepted for bariatric surgery remains controversial (9).

Although these recommendations are established in most bariatric programs, not all patients can comply, and formula diet products as proposed by the industry are not reimbursed by insurance companies in most countries. Despite all dietary preparation, surgeons in every large bariatric surgical program will encounter patients who are not operable because of an insufficient pneumoperitoneum and lack of exposure. This technical infeasibility will only be noticeable upon attempting the operation after the start of the laparoscopy.

In this situation, the surgeon will have to decide how to continue. In our opinion, there are several options, such as performing another surgical procedure than the one planned, e.g., sleeve resection instead of gastric bypass, and converting to an open surgical procedure.

Here, we present a third option. We have found favorable outcomes in such cases when we abandoned the procedure and sent the patient for an intensive, conservative weight loss program with a low-carbohydrate diet, weekly dietary counseling and mandatory weight limits. A second attempt to perform laparoscopic RYGBP was then undertaken.

The results of this approach confirm the aforementioned results obtained from registry data and observational studies and reveal the approach's clinical application in daily practice on individual patients. This report describes our experience with this two-step concept to avoid open surgery and to perform successful laparoscopic RYGBP in technically challenging, obese patients. Here, we present the medical and economic outcomes of this approach.

Methods

Indications for bariatric surgery and preoperative work-up

Three experienced surgeons (MW, SW and MKM, with a total personal experience of more than 1,000 completed bypass procedures) performed 620 gastric bypasses during the study period (2000-2012) at the University Hospital of Zurich. The indications for bariatric surgery were according to the Swiss Study Group for Morbid Obesity (SMOB) guidelines, as follows: body mass index (BMI) >35 kg/m^2 and failed cumulative conservative treatment in the past for >2 years or BMI >50 kg/m^2 and a verifiable diet history for at least one year. All patients provided written consent for the procedure, including the below-mentioned two-step concept.

The preoperative work-up examinations were conducted as specified by SMOB to minimize operative risk, and they included assessments by a multidisciplinary team of surgeons, anesthetists, endocrinologists and psychiatrists.

All patients had 2-3 preoperative nutritional counseling sessions as suggested by international guidelines (S3-Leitlinie: Chirurgie der Adipositas; www.adipositasgesellschaft.de). Patients were encouraged to lose 2-4 kg before surgery, but the main focuses were on teaching healthy nourishment habits and preparing patients for the expected postoperative eating changes. There was no mandatory degree of weight loss before being accepted for bariatric surgery, as this remains controversial (9). Counseling was continued after surgery for as long as required.

Operative technique

Gastric bypass surgery was typically performed laparoscopically unless contraindications for laparoscopy existed, such as previous extensive open abdominal surgery or giant incisional hernias.

All of the laparoscopic bypass procedures were performed as described by Wittgrove and Clark in 1994 (10). The pneumoperitoneum was performed using CO_2 at a maximum pressure of 15 mmHg. The anesthetist was requested to maintain full muscular relaxation. The left liver lobe was retracted with a paddle, which was brought in via a trokar from the right upper abdominal quadrant. The stomach was transected to create a 25 ml pouch. The jejunum was transected 50 cm distal to the duodenojejunal flexure. Gastrojejunostomy was performed using a 25 mm circular stapler. A stapled side-to-side jejunojejunostomy was created with an alimentary limb length of 150 cm. The mesenteric defect at the Roux-en-Y anastomosis was routinely closed with non-absorbable sutures.

Early interruption of surgery

The procedure was discontinued in exceptional cases when a large left liver lobe prevented sufficient exposure of the Angle of His. The decision regarding the early interruption of the intended surgery was made after obtaining a second opinion from another senior bariatric surgeon. Patients were subsequently informed of the change in strategy and sent to a conservative weight reduction program. Weight loss was achieved using strict dietary counseling on an outpatient basis and with a low-carb diet. The patient was monitored thoroughly during the conservative weight reduction to coordinate the optimal time for the bariatric procedure. Patients typically underwent reoperation after approximately 2 months, following achievement of an acceptable amount of conservative weight loss.

Data collection

This study is a retrospective analysis of a prospectively collected database. All of the data were stored in a bariatric database; missing parameters were retrospectively matched with the clinical information system, which maintains all patient data electronically. The study group comprised patients whose first laparoscopic procedure was interrupted and who were sent for conservative weight loss (n=14). Patients who successfully underwent laparoscopic gastric bypass surgery served as the reference group (n=593). For cost analyses, patients who underwent primarily open gastric bypass procedures were also used for comparison (n=13) (Figure 1).

The following parameters were retrieved: i) operating time; ii) length of hospital stay, which was summed for the study group; and iii) complication rates. Complications were reported up to 30 days after surgery and termed early complications; complications were classified according to the Clavien-Dindo classification (11). Feasibility, which was expressed as the rate of conversion to open surgery, was analyzed. Overall hospital stay and complications were compared between groups.

Economic data for all patients were gathered from the hospital administrative system. All of the materials used and all diagnostic tests applied as recorded in the computerized administrative system were assessed. Operating room charges were based on the time used. Surgeons', physicians' and dietitians' costs were calculated based on the time spent with each patient as recorded in the administrative system. Nurses recorded their working time per patient after every shift.

Statistical analysis

Analyses were performed using SPSS® version 15.0 for Windows (SPSS, Chicago, Illinois, USA). The Mann-Whitney *U* test was used to compare continuous variables between two

groups. Categorical variables were compared using the χ^2 test or Fisher's exact test as appropriate. The results are expressed as the means (S.D.) unless indicated otherwise.

Results

Data for 620 patients who underwent gastric bypass surgery were analyzed. Table 1 summarizes the patient demographic and clinical characteristics. Among the patients referred for bariatric surgery, 23% were superobese with a BMI >50 kg/m^2, and 19% were conversions to gastric bypass after failed previous laparoscopic gastric bandings.

In 14 patients (2.3%), the scheduled bariatric procedure was interrupted. These patients were sent to a team of dietitians for conservative weight loss and lost a median of 11 kg (3-21 kg) of body weight after a median of two months of conservative treatment.

The patients in the study group were characterized by heavier body weight, greater excessive weight and a higher BMI relative to patients in the reference group (Table 1). All groups exhibited comparable age, body height and preoperative risk as measured by the ASA score. The gender distribution revealed a trend of more male patients in the study group (50%) than in the reference group (26%).

Definitive reoperation was performed laparoscopically in all cases in the study group (Table 2). The same team of surgeons performed the initial diagnostic laparoscopy and the definitive bariatric bypass procedure. These surgeons reported significantly improved exposure of the upper part of the stomach, which was less obscured by the left liver lobe, in the study group.

The operating time for the diagnostic laparoscopy was 45 minutes. No surgical complications occurred during this time. The operating time for the definitive laparoscopic bypass procedure group was not significantly different than that for the reference group. All patients in the study group underwent subsequent laparoscopic surgery without conversion to open surgery. Three patients in the reference group were converted to open surgery because of technical difficulties (e.g., bleeding and stapler malfunction) during the course of the procedure and after the initiation of gastric transection. The postoperative complication rate was similar between the study group and the reference group. The summed mean hospital stay for the two operations in the study group was significantly longer than the hospital stay in the reference group (median of 12.6 vs. 7.7 days; p=0.013).

With the intensive weight reduction program, patients were able to lose up to 1 kg per week over a period of 6 to 12 weeks. This was achieved with intensive counseling of 3 to 4 sessions per patient at a mean cost of 292 (range 253-330) USD. Cost analyses revealed a significantly greater overall cost per patient for the study group compared with the reference group (27,137 USD vs. 19,601 USD; p=0.034). However, the overall cost for the study group was not significantly different from the overall cost for the open bypass group (30,795 USD; p=0.077).

Discussion

RYGBP is challenging in very obese patients because of an insufficient exposure of the Angle of His or a short and heavy mesentery of the short bowel. These technical difficulties are often solved by conversion to open surgery, but the perioperative outcomes of the laparoscopic approach in bariatric surgery are superior to those of the open surgery approach. In recent years, surgeons have increasingly advocated laparoscopic sleeve resection in these cases, but the exposure at the esophagogastric junction is also crucial for gastric sleeve resection.

The present study describes our experience with a two-step concept that avoids intraoperative conversion to open surgery. The initial laparoscopic procedure is discontinued if gastric bypass is not possible because of inadequate exposure of the Angle of His or a short and heavy mesentery of the short bowel, and the patient is sent for dietary counseling. After adequate weight loss, reoperation is performed. In the present study, RYGBP was performed laparoscopically in all cases. Our analysis demonstrated that conservative weight loss improved the feasibility of laparoscopic surgery with no need for conversion to open surgery on the second surgical attempt and that the patients received all of the possible benefits of a laparoscopic bariatric procedure. There was no difference in postoperative complication rates between the study and reference groups. The two-step concept was more expensive and was associated with longer operating times and hospital stays than was standard laparoscopic RYGBP, but it was comparable to the primary open surgery group in these parameters.

Fourteen of the 620 patients in our study could not initially undergo laparoscopic surgery. The exposure of the gastroesophageal junction and the Angle of His were not adequate, and the intended procedure was interrupted after a second opinion from a senior bariatric surgeon. A massively enlarged left liver lobe was responsible for the infeasibility of exposure in all cases. These patients lost a median of 11 kg (3-21) of body weight in a median time of two months of conservative support by our team of dietitians. A strict diet significantly reduces liver size within a short time (6, 7). The feasibility of laparoscopic bariatric procedures increases as liver size decreases.

The BMIs of these 14 patients were significantly higher than those of the reference group, and 79% of the 14 patients were graded as superobese compared with only 22% in the reference group. Half of these 14 patients were male, compared with only 25% males in the reference group. This disparity is not unexpected because an android body habitus contributes to technical difficulties in the performance of laparoscopic RYGBP (12). Although the literature supports our data, no reliable preoperative factors that predict the intraoperative technical problems of an infeasibility of adequate exposure have been described.

A surgical alternative to our two-step concept is conversion to open surgery. However, laparoscopic RYGBP is associated with less postoperative pain, lower wound infection rates, shorter hospital stays and reduced incidences of late incisional hernia compared with open gastric bypass [6-8]. Therefore, superobese patients benefit from a laparoscopic approach because they tend to experience a greater incidence of postoperative complications, including superficial and deep wound infections, respiratory decompensation and 30-day mortality (13, 14). Our concept demonstrated the possibility of performing laparoscopic RYGBP in all of the patients who were initially deemed inoperable laparoscopically.

Another effective alternative to our two-step concept is laparoscopic sleeve gastrectomy (LSG). However, LSG also requires good exposure of the gastroesophageal junction to successfully complete the partial gastrectomy. Promising data support LSG as a safe first-stage procedure in superobese patients followed by a second-stage bariatric surgery, whether laparoscopic RYGBP or duodenal switch (15). The disadvantage of LSG is that the patient must undergo two procedures with significant postoperative complication rates. There were no complications after our first-step diagnostic laparoscopy, in contrast to a complication rate of up to 5% after LSG (16).

Despite differences in BMI, the complication rate was similar between the study group and the reference group. The complications were classified according to a therapy-orientated grading system and revealed mainly less severe events, i.e., grades CDC I-IIIa, requiring pharmacological or endoscopic interventions. The complication rate of the study group is comparable to other complication rates in the literature (17). However, the overall costs of the study group were significantly higher than those of the reference group, which is not unexpected because the overall hospital stay was longer and two surgeries were performed. However, there was no significant difference in overall cost between the study group and the open bypass group.

Preoperative weight reduction programs are associated with short operative time and length of stay and rapid postoperative weight loss, though the conversion rate is unchanged (18). Thus, fixed weight reduction limits are not routinely recommended (9). In this series, we show that patients who were judged inoperable at the initial laparoscopy can be operated on laparoscopically after a conservative weight loss. This result indicates that the conclusion of the aforementioned study (18) is only applicable to general preoperative weight loss programs and not the procedure of the present study in which technically inoperable patients could be converted to operable patients via weight loss before a second attempt at laparoscopic bariatric surgery.

We attempted an efficiency analysis in interpreting the cost of our two-step procedure. In every 43rd patient, we could not perform the intended laparoscopic gastric bypass procedure, causing an additional cost of 7,500 USD per patient in the 14 patients of this category. Thus, the average extra cost to avoid this scenario with intensive preoperative counseling for all patients may not cost more than 174 USD per patient. However, this approach could not be achieved in our setting. Additionally, if we assume an average maximum weight loss of 1 kg per week with a formula diet and a cost of 56 USD, this approach is not cost efficient.

If we consider only the superobese patients, of whom there were 11 in the study group and 128 in the reference group, every 12th patient could not undergo surgery. Therefore, 625 USD per patient could be invested in intensive, preoperative dietary counseling, with the goal of achieving significant weight loss to avoid the extra cost of 7,500 USD. As this investment cost is below the average cost of our intensive counseling program in the study group of patients, we believe such investment is warranted. Notably, these calculations led us to change our policy regarding superobese patients (BMI >50 kg/m^2), and we have established a fixed, preoperative limit of 10% excess weight reduction before accepting such patients for surgery. We observed that patients in the study group were highly motivated to lose weight, and such a level of motivation is rarely attained during the general preoperative counseling that is given to all patients. This new policy requires further investigation in a future registry analysis.

The results of this study must be considered in the context of several biases. First, the cessation of the initial surgery was a serious decision, and the opinion of a second senior surgeon was considered. However, this choice was a subjective decision, and other expert surgeons may have chosen to complete the initial procedure in one surgery in some cases. Second, the open bypass group was a negative selection of cases that underwent open surgery because of previous open surgeries or giant hernias. All of these conditions increase the operating time and perioperative morbidity. No other open surgery group was available for comparison.

In summary, laparoscopic bariatric surgery may be challenging, particularly in superobese patients. Even after routine preoperative dietary counseling, technical difficulties due to the lack of exposure during laparoscopic bypass surgery are encountered even in large bariatric programs with highly experienced surgeons. Most surgeons attempt to proceed using laparoscopic gastric sleeve resection, which offers the option of second-step gastric bypass after significant weight loss. We accumulated experience using our two-step concept of the interruption of surgery after diagnostic laparoscopy for an intensive conservative weight loss attempt before definitive laparoscopic RYGBP. Our data support the two-step concept based

on the effect of conservative weight loss on liver size, visceral fat mass and increased laparoscopic feasibility. Our two-step concept is an elegant solution that avoids open surgery and minimizes perioperative risk for complications. This approach is not necessary in most cases but remains an option when exposure at the Angle of His is not sufficient. As a consequence of this study, we have now established a fixed, preoperative limit of 10% excess weight reduction before accepting superobese patients (BMI >50 kg/m^2) for surgery. In future studies, we will analyze whether this mandatory preoperative weight reduction with fixed limits in superobese patients is appropriately cost efficient.

Compliance with Ethical Standards:

Conflict of Interest: All authors declare that they have no conflict of interest.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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Tables

Table 1: Preoperative Characteristics

	Study Group (n=14)	**Reference Group (n=593)**	**p (Study Group vs. Reference Group)**
Age (y) median (range)	**37.4 (11.9)** 35 (22-60)	**41.3 (10.4)** 40 (18-67)	**0.143**
Gender (F/M) **% male**	**7/7** **50**	**441/152** **25.6**	**0.060**
ASA mean	**2.9 (0.3)**	**2.7 (0.46)**	**0.183**
Conversion from previous LAGB %	**2** 14%	**114** 19%	**1.000**
Height (m) median (range)	**1.71 (0.13)** 1.55-1.95	**1.67 (0.09)** 1.45-1.98	**0.425**
Weight (kg) median (range)	**165.2 (27.2)** 162 (113-216)	**127.3 (24.1)** 123 (70-238)	**<0.001**
BMI (kg/m^2) median (range)	**55.7 (6.0)** 57 (47-65)	**45.5 (7.1)** 44 (27-86)	**<0.001**
Superobesity (BMI >50) %	**11** 79%	**128** 22%	**<0.001**
Excess weight (kg) median (range)	**101.0 (19.0)** 105 (64-140)	**67.2 (21.6)** 63 (16-208)	**<0.001**

ASA: American Society of Anesthesiologists; LAGB: Laparoscopic Gastric Banding; BMI: Body Mass Index (kg/m^2)
Values are means (SD); Mann-Whitney *U* test for continuous variables, Chi-square test for dichotomous variables.

Table 2: Operating Time, Morbidity and Hospital Stay

	Study Group (n=14)	**Reference Group (n=593)**	**p (Study Group vs. Reference Group)**
Operating time for bypass procedure median (range)	**159 (47.5)** 150 (95-270)	**156 (55.8)** 150 (65-380)	**0.303**
Hospital stay for bypass procedure median (range)	**8.1 (1.7)** 8 (6-13)	**7.7 (4.7)** 6 (4-52)	**0.013**
Conversion to open surgery %	**0** 0%	**3** 0.5%	**1.000**
Early complications %	**3** 21%	**129** 22%	**1.000**
Wound infection (CDC I)	2	21	
PONV (CDC I)		12	
Atelectasis (CDC I)		15	
UTI (CDC II)		9	
DVT (CDC II)		3	
Intestinal bleeding requiring blood transfusions (CDC II)		9	
Anastomotic stricture (CDC IIIa)	1	45	
Intraabdominal / abscess (CDC IIIa)		8	
Anastomotic leakage (CDC IIIb)		7	

Values are means (SD); Mann-Whitney *U* test for continuous variables, Chi-square test for dichotomous variables. PONV: postoperative nausea and vomiting; UTI: Urinary tract infection; DVT: Deep vein thrombosis; CDC: Clavien-Dindo classification (11).

Figures

Figure1: Definitions of the study group, reference group and open bypass group

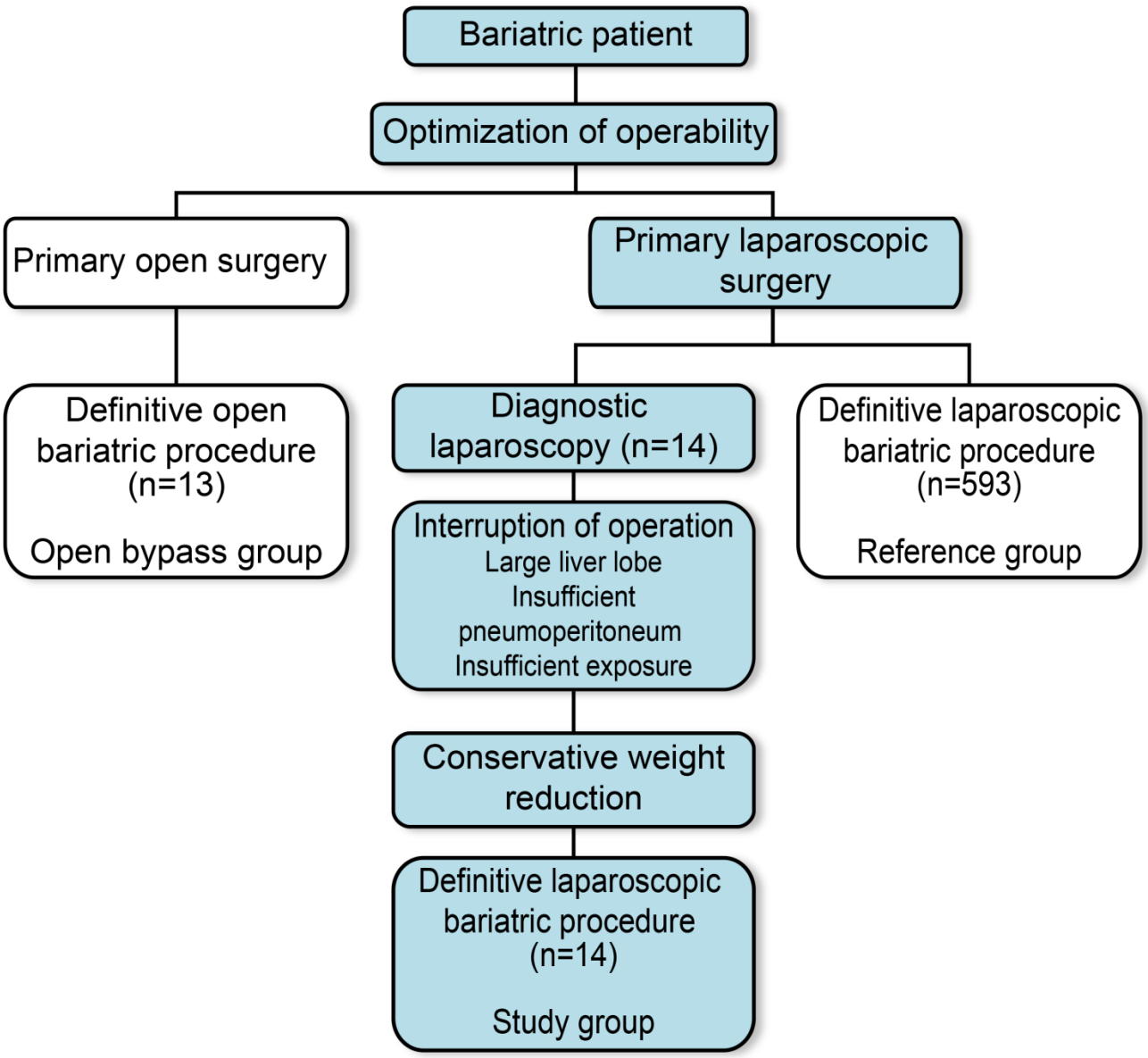

Figure legend

Figure 1: Patients are preoperatively assessed by a multidisciplinary team, and treatment is optimized with preoperative dietary counseling and cardiopulmonary treatment if necessary (e.g., CPAP-therapy, cardiac medication). For cases with extensive previous open surgery or large incisional hernias, a primary open approach is chosen. Laparoscopic surgery is attempted in the majority of cases. The procedure is aborted if it is intraoperatively evident that a laparoscopic operation is not feasible. After a conservative weight reduction, the definitive laparoscopic bariatric procedure is performed.